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CARYOCARIS (CRUSTACEA: PHYLLOCARIDA) FROM THE ORDOVICIAN OF THE CORDILLERA ORIENTAL OF SOUTHERN BOLIVIA

JOSEPH T. HANNIBAL
The Cleveland Museum of Natural History
1 Wade Oval Drive
Cleveland, Ohio 44106-1767

and

RODNEY M. FELDMANN
Department of Geology
Kent State University
Kent, Ohio 44242

ABSTRACT

A specimen of *Caryocaris* Salter from Quebrada de Chaupiuno, northwest Tarija, Bolivia, has well-preserved posterior spinelets. The base of the carapace horn is also preserved. Examination of this specimen allows for a reinterpretation of the morphology of some previously reported specimens of the genus from South America.

Introduction

Caryocaris Salter is a widespread genus of phyllocarid, having been reported from the Ordovician of China (Shen, 1986), New Zealand (Chapman, 1934), Australia (Jell, 1980), Europe and North America (Chlupáč, 1969, p. 44; Rolfe, 1969, p. R316), as well as Peru, Argentina, and Bolivia in South America (Figure 1). *Caryocaris acuta* Bulman, 1931, found in the Ordovician of Peru, was the only South American phyllocarid noted in the comprehensive listing of Van Straelen and Schmitz (1934, Tabulae Geographicae, p. 212). This species has been cited a number of times and was illustrated (fig. 16, 14a) in Camacho's *Invertebrados Fósiles* (1975), published in Argentina. Ahlfeld and Braniša (1960, p. 44) were probably the first authors to note the presence of *Caryocaris* in Argentina, however. They reported *Caryocaris* sp. from the Río Toro area, south of La Quiaca, in the "Arenigian" of northern Argentina. Later, Aceñolaza et al. (1976) described and illustrated specimens of *Caryocaris* from the "Arenigian" of the La Alumbrera River region, Catamarca Province, northwest Argentina. They also noted the occurrence of the genus in the Acoite Formation of Sierra de Cajas, Jujuy Province, northwest Argentina. Ramos (1984), in the most comprehensive paper on Argentinian caryocaridids to date, reviewed most occurrences in that country, corrected misidentifications, and provided a locality map showing their distribution. He also described and illustrated specimens of *Caryocaris* from Piscuno sur, Departamento La Poma, northwest Argentina. Several Bolivian occurrences of *Caryocaris* have been noted by Suárez-Soruco (1976, fig. 26) and Hughes (1980, table 1), who reported *Caryocaris* sp. as occurring in Tremadoc and Arenig faunas, and *Caryocaris acuta* Bulman as occurring in Llanvirn/Llandeilo faunas.

The purpose of this note is to describe a specimen of *Caryocaris* (Hunterian Museum GLAHM 101139) from Bolivia and to briefly comment on other, previously described material from South America. Description of the well-preserved Bolivian specimen makes it possible to reinterpret the fossils previously reported from Argentina.

According to L. Braniša (personal communication to W. D. I. Rolfe), the Bolivian specimen is from Quebrada de Chaupiuno, northwest Tarija, near the junction of the Río San Juan and Río Pilaya (Figure 1, locality 2). It is preserved on a small slab of dark gray siltstone. The specimen is part of a small assemblage, now housed at the Hunterian Museum of Scotland, from the Quebrada de Chaupiuno locality. This assemblage also includes at least one other small slab containing phyllocarid specimens, possibly *Caryocaris*, but the additional material is fragmentary and poorly preserved. Other specimens in this assemblage are preserved in shales that range in color from pale yellowish brown to medium gray to mottled brownish grey and pale red.

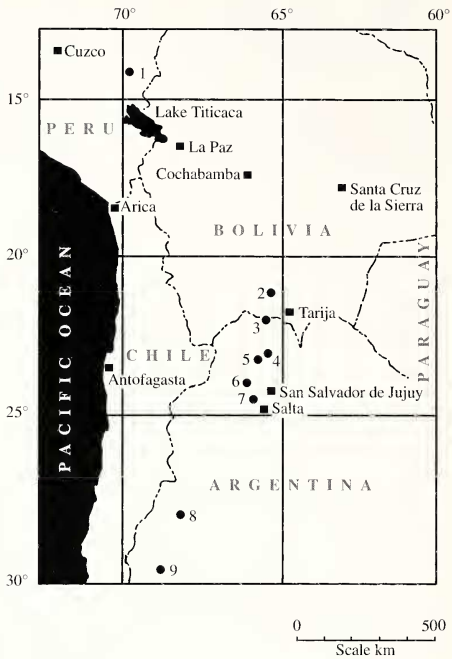

Figure 1. Locality map showing occurrences of *Caryocaris* in South America. 1, Huichiyuni, Peru (Bulman, 1931); 2, Quebrada de Chaupiuno, Bolivia (this paper); 3, Río Toro area, south of La Quiaca, Argentina (Alfeld and Braniša, 1960); 4, Sierra de Cajas, Argentina (localities 4-9 after Ramos, 1984, which contains additional data and references on these occurrences); 5, Sierra de Aguilar, Argentina; 6, Piscuno sur, Argentina; 7, Puerta de Tastil, Argentina; 8, Río La Alumbrera, Argentina; 9, Río Gualcamayo, Argentina.

Because the specimen of *Caryocaris* was collected in the same horizon as the graptolite *Tetragraptus quadribrachiatus* (Hall), it was assigned to the Lower Ordovician (Arenig) by L. Braniša (personal communication to W.D.I. Rolfe, 1962; see also Alfeld and Braniša, 1960, fig. 14). Aceñolaza et al. (1976) also assigned a fauna containing *T. quadribrachiatus* and *Caryocaris* to the Arenig. The distribution of *T. quadribrachiatus,* however, may extend into the Llanvirnian (Aceñolaza and Durand, 1975). Rivas et al. (1969) have described the stratigraphy of the Ordovician of the Tarija area, and have provided a stratigraphic section of the rocks of that area.

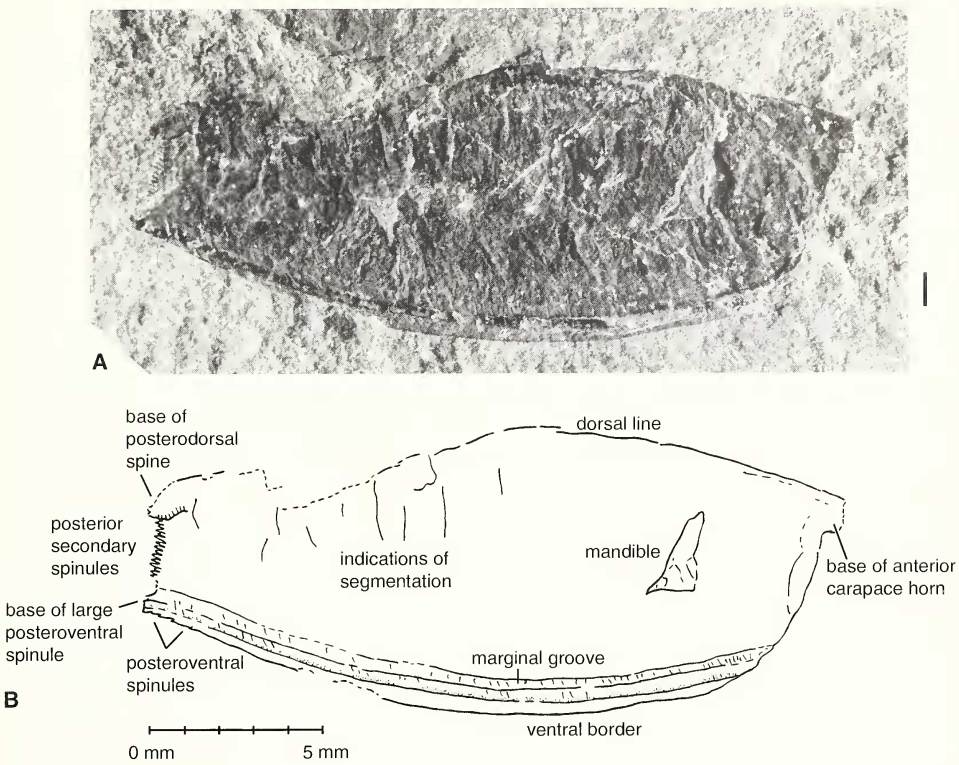

Figure 2. *Caryocaris* sp., Hunterian Museum GLAHM 101139, from Bolivia. A, Entire specimen, scale bar = 1 mm; B, Camera lucida drawing of specimen.

Geologic mapping done just to the south of the Bolivian locality (Pacheo et al., 1991) indicates that the *Caryocaris* specimen probably came from the Pircancha Formation, which is, at least in part, Llanvirnian.

Systematic Paleontology

Superorder PHYLLOCARIDA Packard, 1879
Order ARCHAEOSTACA Claus, 1888
Suborder CERATIOCARINA Clarke *in* Zittel, 1900
Family CERATIOCARIDIDAE Salter, 1860
Genus *CARYOCARIS* Salter, 1863
CARYOCARIS sp.
Figures 2-3

Description

Carapace 20.8 mm long, elongate, average size for genus. Dorsal line moderately convex, maximum valve width 7.9 mm, with greatest width just anterior to midlength. Width of posterior less than that of anterior. Anterodorsal corner produced into base of carapace horn. Anterior margin probably convex. Curved thin groove delineates lunate area adjacent to anterior margin. Ventral margin smoothly and moderately convex. Ventral border wide, with strong, rounded, centrally located ventral ridge separated from carapace by shallow marginal groove (border line). Ridge and groove marked by posterodorsally oriented ornamentation. Ventral border smooth, except for several posteriorly directed, very fine spinules located toward posterior. Posterior margin straight, inclined slightly dorsad, terminating with many short, closely spaced (about nine per mm), posteriorly directed secondary spinules. Posterodorsal and posteroventral corners of carapace produced as bases of posterodorsal spine and large posteroventral spinule.

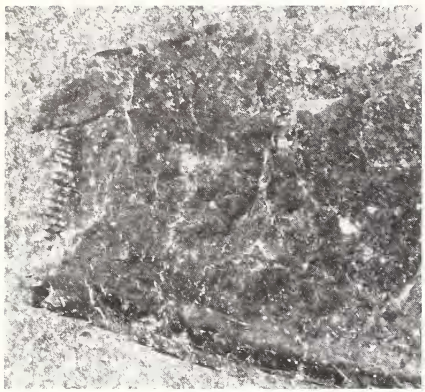

Figure 3. *Caryocaris* sp., Hunterian Museum GLAHM 101139, from Bolivia, close-up of posterior of carapace, showing posterior spinules, scale bar = 1 mm.

Remarks

This specimen probably represents most of the carapace, with the left side folded beneath the right. Most of the exposed part of the specimen is part of the right valve, but in places, for instance along part of the posterior margin, the right valve seems to be broken away, exposing portions of the left valve. This is indicated by a drop, denoted by hachures on Figure 2B, from one layer to another near the posterodorsal corner. Part of the left valve may also be exposed along the anterior margin. It is also possible that the ventral border as interpreted here includes some overlapping parts of both the right and left valve. Most of the carapace is finely and irregularly wrinkled, probably due to taphonomic processes.

The impression of a mandible is preserved toward the anterior of the specimen. This impression shows that the mandible of *Caryocaris* is average sized for a phyllocarid. Transverse markings, approximately equally spaced, in the posterodorsal portion of the carapace provide some indication of thoracic and/or abdominal segmentation impressed through the carapace.

The overall shape of this specimen, coupled with the presence of posterior spinules (Chlupáč, 1969) permits confident placement of this specimen in the genus *Caryocaris*. Comparison of this specimen to other described specimens is hampered, however, by our imperfect knowledge of the morphology of previously described caryocaridids from South America including the Upper Ordovician *Caryocaris acuta,* from Huichiyuni (near Limpucuni), northwest Peru (Bulman, 1931); *Caryocaris* sp. from the Acoite Formation of Argentina (Aceñolaza et al., 1976); and *Caryocaris* sp. from Piscuno sur, Departmento La Poma, Provincia de Salta, Argentina (Ramos, 1984). The Bolivian specimen described here, with a width-to-length ratio of 1:2.7, is less elongate than is *C. acuta,* which, based on Bulman's average measurements, has a width-to-length ratio of 1:3.5. However, this average figure may be skewed by the inclusion of specimens that may be partially enrolled. The very elongate shape of the Peruvian specimen figured by Bulman (1931, pl. xi, fig. 7) suggests enrollment of the holotype. The Bolivian specimen appears to have a more curved dorsum than does the holotype of *C. acuta,* but this could be due to enrollment of the latter specimen. Also, the nature of the posterior of *C. acuta* is not known, hampering comparison.

The overall shape of the carapace of the Bolivian specimen is similar to that of at least some of the specimens from Argentina described and illustrated by Ramos (1984). The length-to-width ratio of the carapace of the Bolivian specimen is also similar to the large specimens described by Ramos. Upon first inspection, however, the Bolivian specimen seems to differ in several ways from the specimen reconstructed by Ramos (1984, fig. 2). Examination of the well-preserved Bolivian specimen suggests a revision of the interpretation of some of the Argentinean material. The "posterior" of the carapace of some illustrated specimens (Ramos, 1984, Pl. 1, at least those specimens seen in figs. a & b) is actually the anterior. The anterior of the carapace of Ramos's reconstruction (fig. 2) is the posterior. This necessitates changing of the position of the telson and abdomen to the other side of the carapace as illustrated. With these changes, this reconstruction more closely resembles the specimen illustrated herein as well as other described specimens of *Caryocaris.*

The apparent lack of carapace spinules, as well as carapace horns, on various previously described specimens of the genus from South America may well be due to poor preservation. If this is so, it argues for the synonymy of *Rhinopterocaris* and *Caryocaris* suggested by Rolfe (p. 183 *in* Theokritoff, 1964; 1969, p. R316; 1981, p. 23). These two taxa were distinguished by the presence or absence of carapace spinules and produced carapace horns.

Caryocaris has often, but not always (Churkin, 1966, p. 377), been found in association with, or in the same layers of strata as, graptolites (Rolfe, 1969, p. R307; Bassett and Berg-Madsen, 1993; Chlupáč, 1969, pp. 66). In fact, Gurley (1896, p. 86-88) described caryocaridids as graptolites! The Bolivian occurrence reported here is like most previous occurrences as far as age and association with graptolites is concerned. The similarity of the carapace of *Caryocaris* to parts of various graptolites, coupled with the presumably close physical relationship of *Caryocaris* to various graptolites as part of Ordovician plankton, has been suggested to be the result of mimicry.

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